

# *Universal Strategies for Problem Solving*

## *Group 1*

Draw or Build a **Model**

Work **Backwards**

## *Group 2*

Organize a **Table**

Look for a **Pattern**

System – Check for **All Possibilities**

## *Group 3*

**Algebra Equations**

**Equal Ratios**



## **Draw or Build a Model**

- 1) The town of Mud Flats lies on Poison Lake. The town of Crooked Knee is west of Mud Flats. Dry Gulch is east of Crooked Knee but west of Mud Flats. Windy Knoll is east of Rocky Ridge but west of Dry Gulch and Crooked Knee. Which town is the furthest west?
- 2) Chris left school and walked 2 km. east, then 3 km. west, then 4 km. east, then 2 km. west, and finally 6 km. east. How many kilometers away from school is Chris now?
- 3) In a car race, Driver A finished 2 minutes behind Driver C. Driver B finished a minute ahead of Driver D, and a minute behind Driver A. List the drivers in the order they finished.
- 4) In a race at school, Jack finished 10 seconds behind Luke. Luke finished 1 minute ahead of Mike. Jenny finished 30 seconds ahead of Mike. List the racers in the order they finished.
- 5) In the next race, Erin finished 5 seconds behind Mary Ann. Cathy finished 8 seconds behind Sammy. Sammy finished 6 seconds ahead of Erin. List the runners in the order they finished.
- 6) A rectangular lot 30m. by 40m. is surrounded on all 4 sides by a concrete walk 5m. wide. Find the surface area of the walk.  

A. $800 \text{ m}^2$	C. $375 \text{ m}^2$
B. $700 \text{ m}^2$	D. $350 \text{ m}^2$
- 7) A square has an area of 100 square feet. What would its area be if the length of its sides were doubled?  

A. 150 sq. ft.	C. 300 sq. ft.
B. 200 sq. ft.	D. 400 sq. ft.
- 8) An equilateral triangle has a perimeter of 24 units. What would happen to its area if its perimeter were reduced to 12 units?



- A. It would be one-sixth as big.      C. It would be one-third as big  
B. It would be one-quarter as big.      D. It would be one-half as big

9) Each piece of paper is one-third of a meter long. How many pieces of paper will it take to make a banner  $6\frac{1}{3}$  meters long?

- A.  $3\frac{1}{6}$  pieces      C. 19 pieces  
B. 6 pieces      D. 21 pieces

10) How many line segments must be added to this shape to make it a prism?

- A. 4  
B. 6  
C. 8  
D. 10

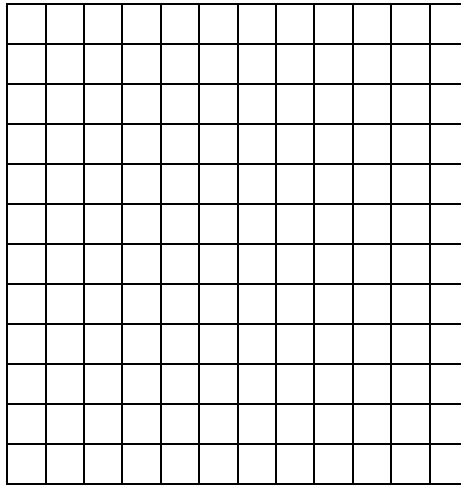


11) If the sides of an equilateral triangle were doubled in length, what would happen to its area?

- A. It would increase by half.  
B. It would double.  
C. It would triple.  
D. It would quadruple.



- 12) What would happen to the area of a square with 10-unit sides if the lengths of its sides were reduced to 5 units? Draw a diagram and explain in words exactly how and why the area would change.



- 13) Rene is arranging 2 dozen tulips from the garden. She groups 2 red with 1 yellow. If she does this for the whole arrangement, how many red tulips did she cut?
- 14) Joe and Matt are putting up signs for the school play. The signs are printed on green and yellow paper. For every 4 green ones there are 2 yellow ones if the boys put up 36 signs, how many will be green?
- 15) Steve is decorating the hall with yearbook photos. He arranges 9 pictures in rows of 3 pictures each. Each picture has 1 tack in each corner, but he uses 1 tack for 2 or more pictures whenever he can.. How many tacks does he use?
- 16) Connie arranges a plate of sandwiches for a party. She has 60 sandwiches. For every 3 ham sandwiches, she has 1 bologna and 1 turkey sandwich. How many ham sandwiches does she have?
- 17) How many ham sandwiches would she have if she needed 300 sandwiches altogether?
- 18) Paul is making a display of his favorite football cards. For every 3 Chiefs cards he includes 2 Packers cards. If he has room for 30 cards, how many Chiefs cards will he display?



19) If Paul decides to add a second display of another 30 cards, so that he can include 1 49er card for every 3 Chiefs and 2 Packers, how many Packers will he have in both displays?

20) If a chicken lays one egg in one minute, how many minutes does it take 3 chickens to lay a total of 3 eggs?

- A.  $\frac{1}{3}$                       C. 3
- B. 1                          D. 9

21) In a class of 30 students, exactly 7 bring tape recorders, exactly 15 bring calculators, and exactly 2 have both. How many of the 30 students have neither?

2. Joann's garden plot is 5 feet by 6 feet.  
Joann decides to double the length and  
the width of the garden.

How does the perimeter of her  
garden change?

- A. The perimeter is one and a half times larger than the perimeter of the original garden.
- B. The perimeter is two times larger than the perimeter of the original garden.
- C. The perimeter is three times larger than the perimeter of the original garden.
- D. The perimeter is four times larger than the perimeter of the original garden.

\* You are building a 40' by 80' basketball court with an extra 10' of gravel around the edges of the court. How many square feet of gravel will you have?

\*\* Two students have to travel 100 km. starting and arriving at the same time. They have a bicycle which they can share but it will hold only one of them at a time. If one student begins riding a certain distance, and then leaves the bicycle behind for the other to use when he catches up, where should the bicycle be left if each student is to finish the 100 km. at the same time. Assume each one walks and rides at the same rate.



## Work Backwards

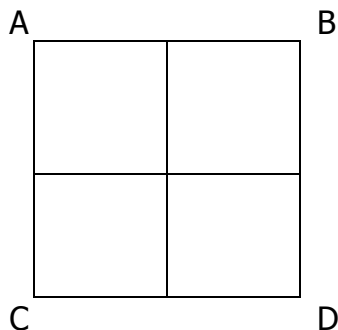
1) When a certain number is divided by 3, the quotient is 240. When that same number is divided by 6, the quotient is...

- A) 720                      C) 120  
B) 480                      D) 80

2) Joe has 34 cents less than Mary. Mary has 67 cents more than Pablo. Pablo has \$3.42. How much money does Joe have?

3) Danny was supposed to multiply a number by 5. By mistake, he divided the number by 5 instead. Danny's answer was 5. The correct answer was?

4) Square ABCD is divided into four smaller squares, as shown in the diagram. The perimeter of each of the four small squares is 4. What is the perimeter of square ABCD?



5) What is the area of square ABCD?

6) If you open a book so the two facing pages are numbered 40 and 41, the product of those two numbers is 1,640. Where do you need to open the book so that the product of the two facing page numbers is 12,656?



25. At Stone Middle School, the band has a concert every 4 weeks and the drama club has a play every 6 weeks. Both groups performed during the first week of school.

When is the next time the band and the drama club will perform in the same week?

- A. in 2 weeks
- B. in 10 weeks
- C. in 12 weeks
- D. in 24 weeks



## Organize a Table

1. Fifteen factory workers decided to improve their workplace by buying three couches at \$279 each, two soda machines at \$489 each, and a big screen TV for \$789. How much does each factory worker have to pay if they split the purchases evenly?
2. \$103.80                      C. \$141.00
3. \$136.40                      D. \$173.60

4. If the rule for this table is  $2y = x$ , what numbers belong in the table as the values for  $x$ ?

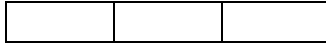
$y$	$x$
2	
5	
7	
10	

5. If the rule for a table is  $4x = y$ , create a table showing what the first four  $y$ 's would be.
6. Students were required to march in an assigned order for 6<sup>th</sup> grade graduation. They marched in pairs, one boy and one girl. The first three pairs of students were made up of Brad, Chuck, George, Maria, Ginny, and Becky. Maria was not Brad's partner. George was not last. Chuck was in front of Maria, and Ginny was last. What order did the three pairs march in? Show all of your work in deciding how they marched.
7. When school is closed due to weather conditions, the principal calls 4 people who work at the school. These 4 people call 3 others, and those 3 each call 2 more people. Each of those 2 people in turn call 1 more person. How many people have been contacted?



How many rectangles are there in each drawing?

8)



9)

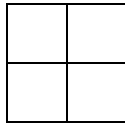


10)

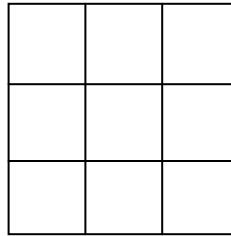


How many squares are there altogether?

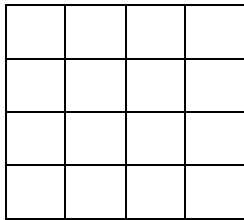
11)



12)



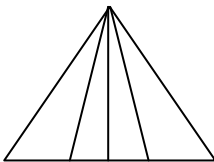
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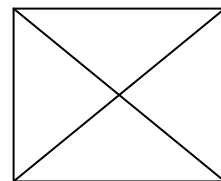
14) On a checker board????

How many triangles are there altogether?

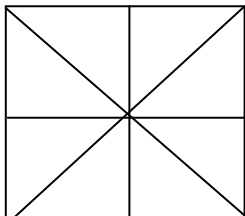
15)



16)



17)



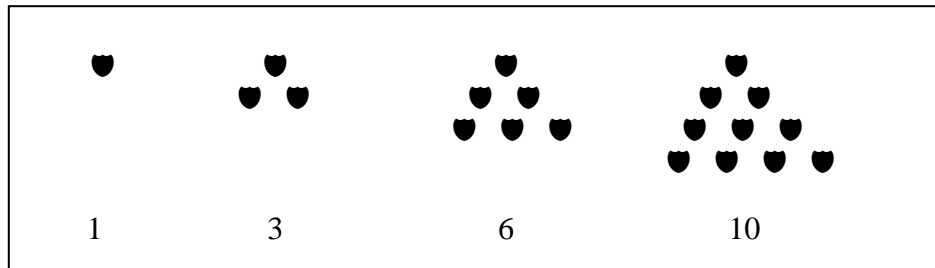


- 18) Cindy, Clark, and Craig each had chili for lunch. One had Mild Puppy chili, one had Big Dog chili, and one had TNT chili. Cindy does not like Big Dog chili. Craig had the Mild Puppy chili. What kind of chili did each of the other 2 eat?
- 19) Four kids stopped for ice cream on the way home. Elise, Neal, Dawn, and Judy each ordered a different flavor.... Peach, blueberry, vanilla, and chocolate. Elise does not like vanilla or chocolate. Dawn's cousin chose chocolate. Neal's favorite is peach.
- 20) A young lady (A) is offered a job as a bank teller with a starting salary of \$10,400 per year. She is told that if her work is satisfactory her salary will increase by \$1040 at the end of each year for the next five years. Her friend (B) is offered a job as a teller at another bank at a starting salary of \$5,200 per half-year. She is told that if her work is satisfactory, her half-year salary will increase by \$260 per half-year at the end of each half-year over the next five years. Who has the best paying job?
- 21) Alex leaves for school at the same time each morning. It takes him 8 minutes to walk to the bus stop, and he waits 10 minutes for the bus to arrive. The bus ride takes 25 minutes. Andy gets to school at 8:20 A.M. What time does he leave for school?
- 22) If I have enough coins to pay the exact price for any item from one cent up to and including one dollar, what is the fewest coins I could have in my pocket? What type are they?



## Look for a Pattern

1) These are the first four triangular numbers. What is the tenth triangular number?



- A. 46                      C. 66  
B. 55                      D. 78

2) A rocket accelerates at this rate. If it keeps accelerating at the same rate, how fast will it be going after 5 minutes?

Time in Minutes	Speed in Km/min.
2	8
3	27
4	64

- A. 100 km/min.                      . C. 150 km/min.  
B. 125 km/min                      D. 200 km/min.

3) What is the rule for this table?

X	Y
4	5
17	18
21	22

- A.  $X + 1 = Y$                       C.  $2X - 1 = Y$   
B.  $X + 1 = 2Y$                       D.  $X = Y$



4) What is the rule for this table?

A	B
14	5
26	9
32	11

A.  $A = 2B$

C.  $A = 3B$

B.  $A = 2B + 1$

D.  $A = 3B - 1$

5) What is the rule for this table?

R	T
10	5
30	15
100	50

A.  $R/2 = T$

C.  $2R = 2T$

B.  $R = T/2$

D.  $4 = R * T$

6) Jan is designing a striped afghan. The first row is blue, the second yellow, and the third is green. Then the pattern repeats. What color will the eleventh row be?

7) Mark is building a triangular display of soup cans at the grocery store. He is using 12 cans for the base and 2 cans less for each successive layer. How many cans does he need?

8) John saves \$3 every week from his allowance. He has \$12 now. How much money will he have in 8 more weeks?

9) Art students created a sculpture that consists of layers of cardboard cubes, each weighing 5 pounds. The bottom layer of the sculpture contains 36 cubes. The second layer contains 25 cubes. The third layer contains 16 cubes and so on. The topmost layer contains just one cube. What is the weight of the sculpture?

A. 91 lb.

C. 455 lb.

B. 450 lb.

D. 385 lb.



31. A pattern is shown.

1, 4, 13, 40, 121, . . .

In your **Answer Document**, describe the rule for the pattern and find the next term. Show how you found the next term in the pattern.



## Use a System – Check All Possibilities

1) Which rule goes with this table?

a	b
21	7
24	8
27	9
30	10

A.  $b^3 = a$

C.  $3 / a = b$

B.  $b * 3 = a$

D.  $3a = b$

2) What rule goes with this table?

X	Y
2	7
3	10
4	13

A.  $X + 5 = Y$

C.  $X + X + 3 = Y$

B.  $3X + 1 = Y$

D.  $4X - 1 = Y$

3) What is the rule for this table?

S	T
3	3
6	4
9	5
12	6

A.  $S = T$

C.  $S - 2 = T$

B.  $S / 2 = T$

D.  $S / 3 + 2 = T$

4) Which statement is NOT true?

A. 15 quarts < 4 gallons

C. 336 hours = 2 weeks

B. 80 inches > 2 yards

D. 60 ounces > 4 pounds



- 5) A Scientist kept track of the effect of wind speed on the distance sand grains would travel at a large sand dune. What expression shows the relationship between how far the sand grains will travel and the wind speed? Let  $x$  equal the wind speed.

Wind speed in km/hour	Distance traveled in meters
50	30
40	25
30	20
10	10

- A.  $3x/5$                       C.  $1/3x$   
B.  $x/2 + 5$                 D.  $2x - 10$

- 6) The same scientist then tracked how different wind speeds affected the distance a sailboat would travel in one hour. Let  $x$  = wind speed.

Wind speed in Km/hour	Distance boat Traveled
5	4
10	14
20	34
30	54

- A.  $x - 1$                       C.  $2x - 6$   
B.  $x - 3 * 2$                 D.  $x * 4 + 10$

- 7) The product of 1000 whole numbers is 1000. What is the largest possible value the sum of these numbers can have?

- A. 1000                      C. 1993  
B. 1992                      D. 1999

- 8) A year is called blackjack if the sum of its digits is 21. For example, 1983 is a Blackjack year because  $1+9+8+3=21$ . How many Blackjack years are there between 1900 and 2000?

- 9) What is one-half of one-half divided by one-half?



13. An input-output table is shown.

Input	Output
2	5
4	6
6	7
8	8
10	9

Which rule describes this input-output function?

- A. double the input, and add 1
- B. add 1 to each input number
- C. add 2 to each input number
- D. divide the input by 2, and add 4



## Algebra Equation

- 1) Carlos found that when he started middle school, his homework load increased by 45 minutes per week. If he had 30 minutes of homework four nights a week in elementary school, how many minutes per week is he doing homework now that he is in middle school?

A.  $30 + 45 = 75$  minutes                      C.  $45 * 4 = 180$  minutes  
B.  $(30 * 4) + 45 = 165$  minutes            D.  $(30 + 45) * 4 = 300$  minutes

- 2) Dianna has  $p$  pairs of shoes. Her sister Cheri has twice that many pairs plus 8. All together, the two sisters own 68 pairs of shoes. How could you find out how many pairs of shoes Dianna owns?

A.  $68 = p * (2p + 8)$                       C.  $p + (2p + 8) = 68$   
B.  $68/p = 2p + 8$                       D.  $3p + 8 + 68/2$

- 3) Amanda decided to take her family to the circus. She bought three children's tickets at \$11.95 each and two adult tickets at \$14.95 each. Once there, she bought five cotton candies at \$4.00 each and three boxes of peanuts at \$3.00 each. How much did Amanda spend for her family?

Which one of these would **NOT** be a good first step in solving this problem?

A.  $5 * (\$11.95 + \$14.95)$                       C.  $(5 * \$4.00) + (3 * \$3.00)$   
B.  $2 * \$14.95$                       D.  $3 * \$11.95$

- 4) Jared, Lucas, and Troy went to the carnival. Lucas brought \$6.00, and Jared brought \$8.00. When Troy joined them, he doubled the amount of money the boys had. What expression represents how much money the boys had all together?

A.  $2(6+8)$                       C.  $2 * 6 * 8$   
B.  $2 + 6 + 8$                       D.  $3 * \$11.95$



- 5) There was a cookie jar on the counter with 140 cookies in it. Of the 140 cookies, 68 were Oreos. Of the remaining cookies, half were chocolate chip and half were peanut butter. How many peanut butter cookies were there?

A.  $\frac{1}{2} * (140-68)$                       C.  $140 * \frac{1}{2}$   
B.  $68 / 2$                               D.  $(140 + 68) * \frac{1}{2}$

What is the actual answer to the question?

- 6) Fred's Flower Shop orders 200 roses and 350 carnations every week. The week before Valentine's Day, however, the shop orders 20 times more flowers. How many roses and carnations will the shop order the week before Valentine's Day?

A.  $20 + (200 * 350)$               C.  $20 (200 + 350)$   
B.  $(20 * 200) + 350$               D.  $20 * 200 * 350$

- 7) Which equation states that two less than six times some number is equal to 100?

A.  $2 - 6a = 100$                       C.  $2 - a * a * a * a * a * a = 100$   
B.  $6a - 2 = 100$                       D.  $a * a * a * a * a * a + 2 = 100$

- 8) Which equation states that 5 more than three times some number divided by 2 is 14?

A.  $(5 + 3) n / 2 = 14$               C.  $3 * n / 2 + 5 = 14$   
B.  $5 + 3(n / 2) = 14$               D.  $3 * n / (2+5) = 14$

- 9) Fifteen less than three times some number is 9. What is the number?



- 10) What expression shows the relationship between the time it takes for a wagon to roll down a steep hill and the distance it rolls? Let  $t$  equal the time in seconds.

Time in seconds	Meters traveled
2	11
5	20
8	29
11	38

- A.  $4t + 3$                       C.  $3t + 5$
- B.  $t^2 - 5$                       D.  $4t - 6$
- 11) Rico joined a CD club in September. During the first year he bought 6 CD's at an average cost of \$6.50 each. He paid an additional \$1.93 for postage and handling per CD. How much did he pay for the 6 CD's altogether. Write an equation showing how this problem can be solved.
- 12) Jed bought 4 sleeves of golf balls. Each sleeve contains 3 balls. After playing one round of golf he had lost 2 balls by hitting them into a pond. On the last hole, however he found one ball in the tall grass. How many golf balls does Jed have now? Write an equation showing how this problem can be solved.
- 13) Write an equation for this problem. Let  $r$  equal the number of cars in the smallest parking lot. Solve the equation. Show all of your work.

There are three parking lots at the stadium. The largest parking lot holds three times the number of cars that the small lot holds. The medium sized lot holds 1.5 times the number of cars that the small lot holds. If there are parking spaces for 550 cars, how many cars does the medium sized lot hold?



- 14) Jimmy has a certain number of mystery books in his collection at home, but you do not know how many. You do know that Polly has twice as many as Jimmy, that Bobby has 4 more than Jimmy, that Colin has 10 fewer than Jimmy, and that Jane has the same number as Jimmy. You also know that all together the children have 90 mystery books. How many does Jimmy have?

Write a mathematical expression to represent each child's number of books. Then write an equation and solve the problem.

Jimmy's books: \_\_\_\_\_

Polly's books: \_\_\_\_\_

Bobby's books: \_\_\_\_\_

Colin's books: \_\_\_\_\_

Jane's books: \_\_\_\_\_

Equation and solutions:

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- 15) If it takes two people about a half an hour to clean up an empty lot, how long would it take 6 people to clean it? Write an equation, then solve the problem.

11. Jared wants to save \$100 to buy a tennis racket. He saves \$8 each week, and his mother gives him an extra \$0.25 for each dollar he saves.

In your **Answer Document**, determine the number of weeks it will take Jared to save \$100. Show your work or explain how you found the number of weeks.



8. What is the value of  $x$  when  $3x + 11 = 20$ ?

A. 3

B.  $\frac{20}{3}$

C. 9

D.  $\frac{31}{3}$

32. Which value for  $f$  makes the inequality  $7f - 9 > 12$  true?

A. when  $f$  is  $-3$

B. when  $f$  is 1

C. when  $f$  is 3

D. when  $f$  is 5

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## Equal Ratios

1) Solve for  $n$ :  $\frac{n}{16} = \frac{6}{192}$

- A. 0.5                      C. 5  
B. 2                          D. 12

2) Solve for  $a$ :  $\frac{3}{a} = \frac{72}{120}$

- A. 2880                      C. 5  
B. 24                          D. 12

3) If the scale on a map is 1 inch : 250 miles, how many inches would represent 1,250 miles?

- A. 5                          C. 10  
B. 7.5                        D. 12

4) If the scale on a map is 1 inch : 150 miles, how many miles represent 4.5 inches?

- A. 9                          C. 3.33  
B. 675                        D. 300

5) Students were surveyed by Candy Express Candy Company to find out what candy they preferred. What was the ratio of suckers to M & M's preferred by Mrs. Takac's class?

Class	M & M's	Suckers
Brisco	15	10
Takacs	11	14
Boardman	20	5

- A. 29 : 46                      C. 11 : 14  
B. 14 : 25                      D. 14 : 11



- 6) Students in Mr. Mayer's science class were doing an experiment with paper moths. Each student was to pick up moths one at a time and record how many of each color they had picked up after 30 seconds. What was the ratio of gray to white moths that Zach picked up?

Student	Moth Color	
	Gray	White
Zach	20	11
Marcus	17	9
Joanne	18	6

- A. 20 to 11      C. 11 to 20  
B. 20 to 31      D. 55 to 26

- 7) There are 18 boys and 11 girls in Mrs. Davis' class. In the whole sixth grade there are 52 boys and 31 girls. Is the ratio of boys to girls the same in Mrs. Davis' class as it is in the whole sixth grade? Prove your answer by determining whether the ratios form a proportion. Show all of your work.

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- 8) Jack was making cookies. The recipe called for  $1\frac{1}{4}$  cups of sugar for 25 cookies. How many cups of sugar would he need to make 60 cookies?

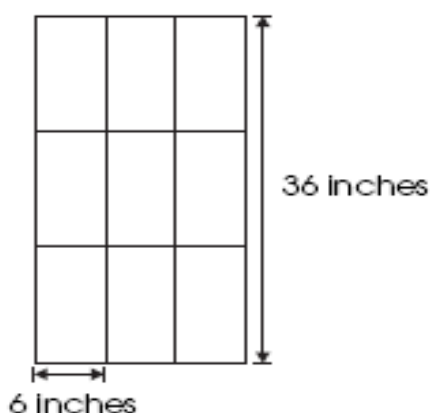
9. The lengths of the sides of a triangle are 3 inches, 4 inches and 5 inches.

Which are the side lengths of a similar triangle?

- A. 6 inches, 7 inches, 8 inches  
B. 6 inches, 8 inches, 10 inches  
C. 9 inches, 12 inches, 20 inches  
D. 9 inches, 16 inches, 25 inches



45. The window shown is divided into 9 smaller windowpanes.



Each small windowpane is similar to the large window. The height of the large window is 36 inches. The width of the small windowpane is 6 inches.

What is the ratio of the height of a small windowpane to the height of the large window?

- A. 1:1
  - B. 1:2
  - C. 1:3
  - D. 1:6
40. A pancake recipe uses 4 eggs to make 14 pancakes. Jeremy has 10 eggs.
- What is the greatest number of pancakes that Jeremy can make?

- A. 14
- B. 18
- C. 35
- D. 56